United Nations A/72/70

General Assembly

Distr.: General
6 March 2017

Original: English

Seventy-second session
Item 78 (a) of the preliminary list*
Oceans and the law of the sea

Oceans and the law of the sea

Report of the Secretary-General

Summary

The present report was prepared pursuant to paragraph 351 of General Assembly resolution 71/257 with a view to facilitating discussions on the topic of focus at the eighteenth meeting of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea, on the theme "The effects of climate change on oceans". It constitutes the first part of the report of the Secretary-General on developments and issues relating to ocean affairs and the law of the sea for consideration by the Assembly at its seventy-second session. The report is also being submitted to the States parties to the United Nations Convention on the Law of the Sea, pursuant to article 319 of the Convention.

* A/72/50.

17-03665 (E) 270317

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I. Introduction

1. In paragraph 339 of its resolution 71/257, the General Assembly decided that the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea would focus its discussions at its eighteenth meeting on the effects of climate change on oceans.

2. To facilitate the discussions, the present report builds on the First Global Integrated Marine Assessment[1] and the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report,[2] together with other reports and scientific, technical and policy studies. In addition, the Secretary-General is grateful for contributions submitted by States and relevant organizations and bodies upon his invitation.[3] They detail action taken to address the effects of climate change and related changes on oceans, in addition to further action necessary to prevent and significantly reduce future effects. The full text of the submissions should be referred to for completeness.[4]

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[1] United Nations, "First Global Integrated Marine Assessment: World Ocean Assessment I" (2016), available from http://www.un.org/depts/los/global_reporting/WOA_RegProcess.htm.

[2] Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2013: The Physical Science Basis — Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, Cambridge University Press, 2013), and *Climate Change 2014: Impacts, Adaptation, and Vulnerability — Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, Cambridge University Press, 2014).

[3] Contributions were received from the Governments of Azerbaijan, Bangladesh, Indonesia, Monaco, Namibia, New Zealand, the Republic of Korea and the United States of America, as well as from the European Union, which included the separate contributions of Estonia, France, Italy and the United Kingdom of Great Britain and Northern Ireland. The Secretary-General also expresses appreciation for the contributions submitted by the following intergovernmental organizations: Baltic Marine Environment Protection Commission (Helsinki Commission), Commission for the Conservation of Antarctic Marine Living Resources, secretariat of the Convention on Biological Diversity, Food and Agriculture Organization of the United Nations (FAO), Intergovernmental Oceanographic Commission (IOC), International Atomic Energy Agency, International Hydrographic Organization (IHO), International Maritime Organization (IMO), International Seabed Authority, North Atlantic Salmon Conservation Organization, North-East Atlantic Fisheries Commission, North Pacific Anadromous Fish Commission, Pacific Community (SPC), United Nations Educational, Scientific and Cultural Organization (UNESCO), secretariat of the United Nations Framework Convention on Climate Change and World Meteorological Organization (WMO). The Department of Economic and Social Affairs of the Secretariat, the Office of the United Nations High Commissioner for Refugees, the Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States, the United Nations Conference on Trade and Development, the United Nations Environment Programme (UNEP) (including the Mediterranean Action Plan (UNEP/MAP)) and the United Nations Human Settlements Programme (UN-Habitat) also made contributions.

[4] Contributions authorized by the authors to be posted online are available from www.un.org/Depts/los/general_assembly/general_assembly_reports.htm. They are identified in the footnotes with the name of the State or international organization that submitted them.

II. Climate change and related changes in the atmosphere: key drivers affecting oceans

3. It is now well understood that oceans and coastal systems are particularly affected by two key drivers linked to climate change and related changes in the atmosphere: ocean warming and ocean acidification.

4. Human-induced warming of the atmosphere and oceans is unequivocal.[5] In fact, most of the heat excess caused by increases in atmospheric greenhouse gases is absorbed by oceans.[6] Their large mass and high heat capacity allow them to store huge amounts of energy. Oceans are estimated to have absorbed about 93 per cent of the combined extra heat stored by warmed air, sea, land and melted ice between 1971 and 2010.[7]

5. Although all ocean basins have warmed during the past decades, the increase in heat content is not uniform across basins.[8] Warming is also not uniform throughout the water column, with the strongest warming found closest to the surface. Oceans are expected to continue to warm during the twenty-first century, with the strongest warming being projected for the surface in tropical and northern hemisphere subtropical regions.[9]

6. Increasing carbon dioxide concentrations in the atmosphere cause both anthropogenic climate change and anthropogenic ocean acidification. Oceans are a major sink of carbon dioxide, having absorbed 30 per cent of anthropogenic carbon dioxide emitted to the atmosphere.[10] Such absorption has benefited humankind by significantly reducing the greenhouse gas levels in the atmosphere and abating some of the impacts of climate change. Nevertheless, oceans' uptake of carbon dioxide is

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[5] Secretariat of the United Nations Framework Convention on Climate Change contribution.

[6] United Nations, "World Ocean Assessment I", chap. 5, sect. 2.3.

[7] Ibid. See also IPCC, *Climate Change 2013: The Physical Science Basis*, p. 260; and Philip C. Reid, "Ocean warming: setting the scene", in D. Laffoley and J. M. Baxter, eds., *Explaining Ocean Warming: Causes, Scale, Effects and Consequences* (Gland, Switzerland, International Union for Conservation of Nature, 2016), p. 17.

[8] For example, the increase in heat content in the Atlantic during the past four decades exceeds that of the Pacific and Indian oceans combined (United Nations, "World Ocean Assessment I", chap. 5, sect. 2.3). In addition, in recent decades the Baltic Sea region has warmed up more swiftly than the global average. This accelerated warming is continuing and is expected to do so throughout the twenty-first century (Helsinki Commission contribution). The shallow waters of the Mediterranean Sea have already warmed by almost 1°C since the 1980s (UNEP contribution). The Republic of Korea reported an increase in sea surface water temperature of 2.5 times higher than the global increase in mean sea surface temperature for the same period, mostly owing to features in this semi-enclosed area, long-term changes to the Siberian High and the Pacific Decadal Oscillation and the effect of the Tsushima Warm Current (Republic of Korea contribution). Model studies indicate that the Southern Ocean and the subarctic seas of the Arctic Ocean will become more stratified, which will result in fresher, warmer surface ocean waters in the polar and subpolar regions, significantly altering their chemistry and ecosystems (see United Nations, "World Ocean Assessment I", chap. 4, sect. 1; see also IPCC, *Climate Change 2014: Impacts, Adaptation, and Vulnerability*, pp. 1664-1672).

[9] IPCC, "Summary for policymakers", in *Climate Change 2013: The Physical Science Basis*; see also pp. 263 and 278.

[10] Ibid., sect. B.5.

having a significant effect on the chemistry of seawater, which is becoming more acidic, a process described as ocean acidification.[11]

7. Oceans absorb atmospheric carbon dioxide mainly through two processes: physical air-sea flux at the ocean surface[12] and active biological uptake.[13] As more anthropogenic carbon dioxide is emitted, oceans absorb greater amounts, leading to increasing ocean acidification.[14] Seawater acidity has increased by an average of 30 per cent since the beginning of the industrial era and, if the current emissions scenarios persist, a 170 per cent increase is projected by the end of the current century.[15] Consequently, the chemical capacity of oceans to take up more carbon dioxide is diminishing, compromising their efficiency as carbon sinks.[16]

III. Environmental, economic and social impacts of ocean warming and acidification

8. The aforementioned drivers have serious effects on oceans, including rising sea levels, increased acidity and reduced mixing of ocean water and nutrients owing to stratification and deoxygenation. The results of these effects include loss of life, destruction of property, erosion of coastlines, migration of fish stocks, coral bleaching and other ecosystem degradation. These impacts act as threat multipliers by combining with other anthropogenic impacts, thus exacerbating challenges relating to food security, livelihoods and the development of communities. This in turn undermines the ability of States, in particular least developed countries and small island developing States, to achieve sustainable development and in some cases threatens the viability and survival of communities and even nations, in particular in low-lying coastal countries.

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[11] Ibid., box 3.2, p. 295; see also European Union and IOC contributions.

[12] Colder water can take up carbon dioxide more than warm water and, if this cold, denser water sinks to form intermediate, deep or bottom water, there is transport of carbon away from the surface ocean and thus from the atmosphere into the interior of oceans. This "solubility pump" helps to keep the surface waters of oceans on average lower in carbon dioxide than the deep water, a condition that promotes the flux of the gas from the atmosphere into oceans (see United Nations, "World Ocean Assessment I", chap. 5, p. 16).

[13] Phytoplankton take up carbon dioxide from the water in the process of photosynthesis, some of which sinks to the bottom in the form of particles or is mixed into the deeper waters as dissolved organic or inorganic carbon. Part of this carbon is permanently buried in the sediments and the other part enters into the slower circulation of the deep ocean. This "biological pump" serves to maintain the gradient in carbon dioxide concentration between the surface and deep waters (see United Nations, "World Ocean Assessment I", chap. 5, p. 16).

[14] IPCC, "Carbon and other biogeochemical cycles", in *Climate Change 2013: The Physical Science Basis*.

[15] Wendy Broadgate and others, "Ocean acidification: summary for policymakers — third symposium on the ocean in a high-CO_2 world" (Stockholm, International Geosphere-Biosphere Programme, IOC, Scientific Committee on Oceanic Research, 2013). Available from www.igbp.net.

[16] Currently, that capacity is only 70 per cent of what it was at the beginning of the industrial era, and it may well be reduced to only 20 per cent by the end of the twenty-first century. See *WMO Greenhouse Gas Bulletin*, No. 10 (September 2014); and Laffoley and Baxter, eds., *Explaining Ocean Warming*, p. 17)

A. Ocean warming

9. Ocean warming is expected to have a substantial impact on specific species[17] and a broader impact on ecosystems and biodiversity.[18] The clear attribution of the impacts of climate change on biological systems is often difficult owing to a lack of long-term data, a limited understanding of the combined effects of diverse chemical and physical factors and the impact of other human drivers on aquatic systems. Moreover, these impacts depend on the region and latitude. Nevertheless, temperature-related changes in biological systems in all major ocean systems have been observed or are predicted.[19]

10. These changes are wide ranging and significant. They include changes in the range, distribution and productivity of marine species, the loss or degradation of coastal habitats and the loss of related ecosystem services, with corresponding socioeconomic impacts, such as challenges to food security, livelihoods and health.[20]

11. Projected rising temperatures are likely to result in changes in the distribution of marine species and can significantly influence the reproductive cycles of fish, including the speed at which they reach sexual maturity, the timing of spawning and the size of the eggs that they lay.[21] The distribution ranges of most marine species will shift towards the poles and deeper water, resulting in the redistribution of catch potential for fish and invertebrates.[22] This will shift provisioning services to benefit the middle and moderately high latitudes (often highly developed) at the expense of low latitudes, where small-scale (subsistence) fishing is important for food security.[23]

12. The impacts of ocean warming on marine ecosystems, such as coral reefs and coastal wetlands, are also expected to affect the productivity and resilience of connected species. Coral bleaching has already significantly damaged most coral reefs around the world and is projected to become more frequent and more severe with climate change, threatening the many coral reef ecosystem services on which hundreds of millions of coastal dwellers depend for fish production and fisheries, coastal protection, ecotourism and other community uses of coral reefs.[24] In a

[17] Ocean warming may have a wide range of impacts on marine species, including plankton, shellfish, fish, seaweeds and seagrasses and corals. Marine organisms specialize in a limited range of ambient temperatures that allows for optimal performance. Changes in ocean temperatures beyond this range affect growth, body size, behaviour, immune defences, feeding and reproductive success (see Organization for Economic Cooperation and Development (OECD), *The Ocean Economy in 2030* (Paris, OECD Publishing, 2016)).

[18] FAO contribution.

[19] Anika Seggel, Cassandra De Young and Doris Soto, *Climate Change Implications for Fisheries and Aquaculture: Summary of the Findings of the Intergovernmental Panel on Climate Change Fifth Assessment Report*, FAO Fisheries and Aquaculture Circular, No. 1122 (Rome, FAO, 2016).

[20] FAO, IOC, International Seabed Authority, UNEP, UNESCO, secretariat of the United Nations Framework Convention on Climate Change and WMO contributions.

[21] FAO contribution.

[22] IPCC, "Carbon and other biogeochemical cycles", in *Climate Change 2013: The Physical Science Basis*; see also FAO and IOC contributions.

[23] See A/70/112, para. 169.

[24] IOC contribution.

business-as-usual scenario, severe bleaching will occur annually on 99 per cent of the world's coral reefs within the current century and for the majority of the reefs in the world as early as the 2040s.[25] The increased virulence of pathogens is also likely to significantly affect marine species and ecosystems, including coral reefs, where reduced reproduction and increased coral mortality will reduce habitat quality for reef-dwelling species.[26]

13. The impacts of ocean warming on individual species and ecosystems are having a cumulative effect on marine biodiversity, leading to global homogenization as vulnerable species become extinct and alien species become established across the world's oceans.[27]

14. Ocean warming is also predicted to reduce the mixing of atmospheric oxygen (deoxygenation)[28] into mid-depth and deep parts of oceans by increasing stratification,[29] decreasing vertical mixing and altering ocean circulation patterns.[30] Such warming could also release frozen methane hydrates stored in the sea floor at water depths of 200-2,000 m (estimated at 2.5 Gt) into the ocean and ultimately into the atmosphere.[31]

15. The above-mentioned effects have already begun to have significant social, cultural and economic impacts, including losses in coastal protection, fisheries, tourism and recreation and decreased carbon storage being provided by coral reefs, mangroves and coastal wetlands.[32] The most significant and immediate socioeconomic impacts of ocean warming will be felt by the people and industries most directly dependent on living marine resources, including coastal communities who depend on small-scale fisheries for protein and income, companies in the fishery value chain and marine/coastal tourism, in particular in least developed countries and small island developing States.[33] The sustainability of ocean-based economies in coastal communities will be jeopardized, endangering livelihoods and sustainable development opportunities. Fisheries and aquaculture-dependent

[25] UNEP contribution.

[26] Ibid.

[27] Laffoley and Baxter, *Explaining Ocean Warming*.

[28] Warmer water holds less oxygen, meaning that oxygen concentrations are declining even near the surface of oceans. Increasing temperatures also increase the metabolic requirements of organisms. Consequently, the need for oxygen is rising at the same time that a multitude of processes that contribute to ocean deoxygenation reduces the supply (UNESCO contribution).

[29] See A/70/12, para. 51.

[30] See ibid., para. 52.

[31] In fact, the heat and carbon dioxide accumulated in the ocean are not permanently locked away, but can be released back to the atmosphere when the ocean surface is anomalously warm, giving a positive rapid feedback to global warming (see Laffoley and Baxter, *Explaining Ocean Warming*, pp. 10 and 17).

[32] It is estimated that wetlands sequester carbon at a rate two to four times greater than mature tropical forests and store three to five times more carbon per equivalent area than tropical forests (see A/70/74, para. 70).

[33] UNEP contribution.

economies, coastal communities, fishers, fish farmers and workers along the value chain are expected to experience the effects of climate change in various ways.[34]

16. There are also signs that human health is being affected by the enhanced survival and spread of tropical diseases with increasing ocean temperatures, in particular pathogenic species of bacteria in the genus *Vibrio* (a cause of cholera) and harmful algal bloom species that cause neurological illnesses. Human disease risk is affected by changes in disease incidence for marine species that are part of our diet, allowing for the direct transmission of the pathogen to humans or for infections of wounds exposed during recreational activities.[35]

Sea level rise

17. Between 1901 and 2010, global sea level rise accelerated and the recent rise appears to have been the fastest in at least 2,800 years.[36] During the past four decades, 75 per cent of the rise can be attributed to glacier mass loss and ocean thermal expansion.[37] Nevertheless, even if the global mean temperature is stabilized, sea levels are projected to continue to rise for centuries, as the deep areas of oceans slowly warm and the large ice sheets find a new surface mass balance.[38]

18. Sea level rise leads to coastal erosion, inundations, storm-related floods, the encroachment of tidal waters into estuaries and river systems, the contamination of freshwater reserves and food crops, the loss of nesting beaches and the displacement of coastal lowlands and wetlands.[39] It has a particular adverse impact on mangroves, seagrasses and intertidal areas and on the species that rely on them, many of which are commercially valuable. It can affect endemic and habitat-forming benthic species, given that they are highly vulnerable to water level changes and coastal erosion.[40]

19. The impacts of sea level rise interact with and amplify other existing anthropogenic or natural forms of pressure that affect coastal areas, including urban development, fishing, aquaculture, tourism, damming, extraction of materials, marine biological invasions, coastal subsidence and tectonic movements.[41]

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[34] For example, changes such as a possible shift towards less primary production of plankton and diminished cold-water seaweed harvest, in addition to changes in the distributions and productivity of fish stocks and shellfish, would affect human food production and may have serious implications for food security (see OECD, *The Ocean Economy in 2030*). Greater uncertainty for fisheries results in social and economic impacts, complicating sustainable management (see also United States, North Pacific Anadromous Fish Commission and SPC contributions). As predicted by IPCC, vulnerability would be highest in developing tropical countries involving a risk of reduced supplies, income and employment from marine fisheries (see IPCC, *Climate Change 2014: Impacts, Adaptation, and Vulnerability*).

[35] Laffoley and Baxter, *Explaining Ocean Warming*.

[36] Robert E. Kopp and others, "Temperature-driven global sea-level variability in the common era", *Proceedings of the National Academy of Sciences of the United States of America*, vol. 113, No. 11 (March 2016).

[37] IPCC, "Summary for policy makers", in *Climate Change 2013: The Physical Science Basis*.

[38] Ibid., "Technical summary", in *Climate Change 2013: The Physical Science Basis*. See also secretariat of the United Nations Framework Convention on Climate Change contribution.

[39] Helsinki Commission and UNEP contributions.

[40] Laffoley and Baxter, *Explaining Ocean Warming*.

[41] UNEP/MAP contribution.

20. The impact of sea level rise is particularly significant on coastal regions and communities, not only because they are physically most exposed to it but also because they have very high population densities.[42] Slow-onset hazards, such sea level rise and coastal erosion, will cause people to flee their homes. In particular, sea level rise poses a significant risk to small island developing States[43] and other low-lying States and their efforts to achieve sustainable development and, for many, represents the gravest of threats to their survival and viability, including through the loss of territory for some.[44] It is estimated that at least 11 to 15 per cent of the population of small island developing States live on land with an elevation of 5 m or lower,[45] and that sea level rise of 0.5 m could displace 1.2 million people from low-lying islands in the Caribbean Sea and the Indian and Pacific oceans — that number would almost double if the sea level were to rise by 2 m.[46] Low-lying islands provide no possibility of retreat from sea level rise, leaving their populations with no other alternative than moving elsewhere, threatening their survival and viability.

21. Sea level rise is also projected to have significant implications for infrastructure and transportation, including ports, airports, railways and access roads located in coastal areas, increasing management and repair costs.[47] In turn, this will have an adverse impact on the sustainability of trade, food, energy and tourism[48] and cause interruptions in the mobility of local communities and world trade.[49] The potential costs associated with damage to harbours and ports stemming from sea level rise could be as high as $111.6 billion by 2050 and $367.2 billion by the end of the century.[50]

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[42] In 2005, 400 million people lived in 136 large coastal cities. Just accounting for the increase in population, property and value of these cities, it is estimated that, in the coming 50 years, damages relating to sea level rise could rise from $6 billion per year to $52 billion per year and be as high as $1 trillion or more per year if flood defences are not upgraded. A European initiative, on the projection of the economic impacts of climate change in sectors of the European Union based on bottom-up analysis, estimates that the average annual costs from sea flood damage will increase from €163 million to €903 million in the 2080s in the southern Mediterranean alone (UNEP/MAP contribution).

[43] Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States contribution.

[44] See resolution 66/288, annex.

[45] UN-Habitat contribution.

[46] Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States contribution; see also Biliana Cicin-Sain and others, "Toward a strategic action roadmap on oceans and climate: 2016 to 2021", paper prepared for the Global Ocean Forum, Washington, D.C., October 2016, p. 16; see also UN-Habitat, *Urbanization and Climate Change in Small Island Developing States* (Nairobi, 2015). Available from https://unhabitat.org/books/urbanization-and-climate-change-in-small-island-developing-states/.

[47] United Nations Conference on Trade and Development contribution.

[48] UNEP/MAP contribution. Nevertheless, the vulnerability of coastal tourism is difficult to assess because the impact of sea level rise may lead to a redistribution, rather than a disappearance, of tourist fluxes.

[49] An estimated 80 per cent of the volume of such trade is carried by sea and enters the markets through ports and coastal transport infrastructure (United Nations Conference on Trade and Development contribution); see also http://unctad.org/en/Pages/DTL/TTL/Legal/Climate-Change-and-Maritime-Transport.aspx.

[50] Kevin J. Noone, Ussif Rashid Sumaila and Robert J. Diaz, eds., *Managing Ocean Environments in a Changing Climate: Sustainability and Economic Perspectives* (Burlington, Massachusetts, Elsevier Press, 2013). Available from http://www.sciencedirect.com/science/book/9780124076686.

Melting ice in polar regions

22. Ice shelves are melting at unprecedented rates also as a result of ocean warming,[51] and the contribution of melting continental ice sheets to sea level rise is accelerating.[52] These rates are projected to further increase in the coming years,[53] possibly at paces much greater than currently estimated,[54] given that ice disappearance has a multiplier effect by reducing surface reflection that, in turn, further increases surface melting.[55] In addition, the previously underappreciated processes of how atmospheric warming causes the hydrofracturing of buttressing ice shelves and the structural collapse of ice cliffs is now understood to give Antarctica alone the potential to contribute more than 1 m of sea level rise by 2100 and more than 15 m by 2500.[56]

23. Given that the polar ice sheets of Greenland and Antarctica are the largest reservoirs of freshwater on the planet,[57] their melting will not only dramatically increase sea level rise globally, including its socioeconomic impacts, but also cause severe effects, such as changes in the salinity of oceans, and possibly alter ocean currents and their mitigating impact on the climate of many countries.[58]

24. Reduced sea ice, especially a shift towards less multi-year sea ice, will affect a wide range of species in those waters.[59] In the Arctic region, permafrost coasts have been increasingly eroded, resulting in the release of nutrients and pollutants into oceans. How the habitat of these areas and the ocean life of these regions are exactly affected is yet to be understood.[60]

25. The reduction of Arctic sea ice could open up new navigational routes in the region, possibly making trans-Arctic shipping economically viable and oil and gas extraction, mining and tourism more accessible. The potential economic and social benefits of such activities notwithstanding, they would pose a threat to the highly vulnerable Arctic ecosystem.[61]

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[51] Ala Khazendar and others, "Rapid submarine ice melting in the grounding zones of ice shelves in West Antarctica", *Nature Communications* 7, article No. 13243 (October 2016).

[52] WMO contribution.

[53] IPCC, "Technical summary", in *Climate Change 2013: The Physical Science Basis*, p. 98.

[54] Ibid., p. 89.

[55] OECD, *The Ocean Economy in 2030*, p. 81.

[56] Robert M. DeConto and David Pollard, "Contribution of Antarctica to past and future sea-level rise", *Nature*, vol. 531, No. 7596 (March 2016). Available from http://www.nature.com/articles/nature17145.epdf.

[57] United Nations, "World Ocean Assessment I", chap. 4, p. 2.

[58] DeConto and Pollard, "Contribution of Antarctica to past and future sea-level rise".

[59] United Nations, "World Ocean Assessment I", summary. For example, owing to low reproductive rates and long lifetimes, some iconic species, including the polar bear, will be challenged to adapt to the current fast warming of the Arctic and may be extirpated from portions of their range within the coming 100 years.

[60] Joseph R. Fonseca, "Retreating Arctic coasts cause drastic changes", Marine Technology News, 4 January 2017. Available from http://www.marinetechnologynews.com/news/retreating-arctic-coasts-cause-543334.

[61] OECD, *The Ocean Economy in 2030*, p. 83.

Extreme weather events

26. Ocean warming has been linked to extreme weather events as increasing seawater temperatures provide more energy for storms that develop at sea, leading to fewer but more intense tropical cyclones globally; changes in phenomena such as El Niño also result in significant changes in weather patterns on land.[62] This is accompanied by a pronounced poleward movement of the latitude at which the maximum intensities of storms occur, affecting coastal areas that have not previously been exposed to the dangers caused by tropical cyclones.[63] Many coastal areas will experience the effects of sea level rise described in paragraphs 18-21 above.

27. Extreme weather events and their impacts on oceans severely affect coastal communities through the widespread loss of life and the extensive destruction of infrastructure, settlements and facilities that support their livelihoods and existence.[64] Exposure to climate change-related hazards will increase as coastal populations and assets in coastal areas continue to grow, especially in highly vulnerable urban communities living in informal settlements.[65] This may result in huge numbers of displaced persons, who will also be immediately exposed to shortages of food, water and fuel while the destruction of port facilities and the creation of new navigational obstacles may impede adequate emergency response.[66] It has been reported that 21.5 million people, on average, have been forcibly internally displaced by weather-related sudden onset hazards per year since 2008.[67]

28. Tropical cyclones have a direct impact on coral reefs, mangroves, seagrasses and intertidal areas through physical damage, the resuspension of sediments, pulses of nutrient enrichment and freshwater inundation, altering their extent and structural complexity and thus their benefit as fish habitats.[68]

B. Ocean acidification

29. Ocean acidification is one of the largest threats to marine organisms and ecosystems.[69] There is high confidence that it will increase for centuries if carbon dioxide emissions continue and will strongly affect marine ecosystems.[70]

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[62] United Nations, "World Ocean Assessment I", chap. 5.

[63] Ibid.

[64] IHO contribution.

[65] UNEP contribution.

[66] IHO contribution.

[67] Alexandra Bilak and others, "Global report on internal displacement" (Geneva, Internal Displacement Monitoring Centre, 2016). Available from http://www.internal-displacement.org/assets/publications/2016/2016-global-report-internal-displacement-IDMC.pdf.

[68] The destruction of coral reefs through cyclones can also lead to increased algal blooms as a result of the upheaval and damage. Changes in the density and biomass of fish species are common after such events and may result in reductions in critical ecosystem functions, potentially leading to regime shifts to less desirable benthic assemblage types (SPC contribution).

[69] Nathalie Hilmi and others, eds., *Bridging the Gap between Ocean Acidification Impacts and Economic Valuation: Regional Impacts of Ocean Acidification on Fisheries and Aquaculture* (Gland, Switzerland, International Union for Conservation of Nature, 2015), p. 19.

[70] IPCC, *Climate Change 2013: The Physical Science Basis*, p. 16.

30. Ocean acidification affects calcifying organisms, such as corals, because their ability to build shell or skeletal material depends on the acidity of the water. As acidification intensifies, this problem will become more widespread and occur in wild, as well as in cultured, stocks.[71] Ocean acidification also affects other marine biota, including by reducing survival, development and growth rates.[72] It therefore directly affects important components of the ocean food web, such as primary producers (plankton), coral reefs, shellfish and crustaceans; marine species that are important in capture fisheries and mariculture are also affected.[73] Coral reefs, in particular, are very sensitive to ocean acidification, with 60 per cent of reefs currently threatened, a number that will rise to 90 per cent by 2030 and about 100 per cent by 2050.[74]

31. Socioeconomic impacts include impacts on food security and the livelihoods of fishing and aquaculture communities. Many such communities are especially vulnerable because they have fewer alternative livelihoods.[75] Other impacts, described in a previous report of the Secretary-General on oceans and the law of the sea to the General Assembly in connection with the meeting of the Informal Consultative Process focusing on the impacts of ocean acidification on the marine environment, also remain valid.[76]

C. Cumulative impacts

32. The joint impacts of ocean warming and ocean acidification can be significant.[77] For example, ocean acidification affects the carbon cycle and the stabilization of atmospheric carbon dioxide (see para. 6 above), hence potentially exacerbating anthropogenic climate change and its socioeconomic impacts.[78] The cumulative effects of these impacts may cause changes at a pace such that marine ecosystems and species would not have sufficient time to adapt.[79] Moreover, these impacts cumulate with other human-induced stresses, such as unsustainable coastal development, overexploitation of living marine resources, habitat alteration and pollution.[80] While ocean warming is arguably the most pervasive environmental stressor associated with global climate change, it rarely operates independently of other regional and local conditions.

33. Marine ecosystems and biodiversity that may be resilient to one form or intensity of impact can be much more severely affected by a combination of

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[71] United Nations, "World Ocean Assessment I", summary.

[72] Ibid.

[73] See A/68/159, para. 11; and SPC contribution for ocean acidification impacts on Pacific tuna and other pelagic species.

[74] Monaco contribution.

[75] Hilmi and others, eds., *Bridging the Gap between Ocean Acidification Impacts and Economic Valuation*, p. 3.

[76] See A/68/71, paras. 33-39.

[77] IPCC, *Climate Change 2013: The Physical Science Basis*, p. 67; see also Hilmi and others, eds., *Bridging the Gap between Ocean Acidification Impacts and Economic Valuation*, p. 3; see also Monaco contribution.

[78] See A/68/71, paras. 33-39.

[79] See A/68/159, para. 10.

[80] Monaco, European Union, UNEP and UNESCO contributions.

impacts, with the total impact of several forms of pressure on the same ecosystem often being much larger than the sum of the individual impacts. It has been observed that, where biodiversity has been altered, the resilience of ecosystems to other impacts, including climate change, is often reduced.[81] Building ecological resilience will thus depend largely on addressing the cumulative impacts of human activities on the marine environment and the unique challenges faced by mutually reinforcing stressors.

IV. Current action and further needs with regard to cooperation and coordination in addressing the effects of climate change and related changes in the atmosphere on oceans

34. The interlinkages between climate change and oceans, including associated environmental and socioeconomic impacts (see sects. II and III), call for diverse and cross-sectoral responses to address the effects of climate change and related changes in the atmosphere on oceans. Cooperation and coordination and integrated approaches at all levels are therefore essential in the planning and implementation of successful action to tackle this global challenge.

35. Many organizations and bodies address aspects of climate change and its effects on oceans, mainly from a sectoral perspective. The General Assembly is the only global policymaking body that thus far has addressed the issue in an integrated and non-sector-specific manner with a view to enhancing cooperation.[82] Cognizant that awareness-raising among relevant sectors and stakeholders is key to facilitating cooperation and coordination, the Assembly has recognized the importance of raising awareness of the adverse impacts of climate change on the marine environment and marine biodiversity, including in the context of the United Nations Framework Convention on Climate Change (see also paras. 39 and 52-53 below).

36. Set out in the present section is information on current action to tackle the effects of climate change and related changes in the atmosphere on oceans, with a particular focus on identifying areas in which coordination and cooperation could be enhanced.

A. Legal and policy frameworks

37. Several international legal and policy instruments contain measures to tackle the effects of climate change on oceans, including by providing for the enhancement of marine ecosystems' resilience, supporting adaptation and mitigation action or providing frameworks to take on related challenges.

38. Under the United Nations Convention on the Law of the Sea, which contains the legal framework within which all activities in oceans and seas must be carried out, States are required to protect and preserve the marine environment, including

[81] United Nations, "World Ocean Assessment I".

[82] See resolutions 61/222, 62/215, 63/111, 64/171, 65/37 A, 66/321, 67/78, 68/70, 69/245, 70/235 and 71/257.

from pollution[83] from or through the atmosphere.[84] States are also required to conserve and manage living marine resources, as also elaborated in the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.[85] Similarly, under the Convention on Biological Diversity, States are required to conserve and sustainably use marine biodiversity, by establishing, among other things, a system of protected areas or areas where special measures need to be taken,[86] thereby contributing to enhancing ecosystem resilience.[87]

39. Set out in the United Nations Framework Convention on Climate Change is the global legal regime to stabilize greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system to, among other things, allow ecosystems to adapt naturally to climate change and to ensure that food production is not threatened.[88] Recognized in the Convention and the Paris Agreement are the role of oceans in mitigating greenhouse gas emissions[89] and the importance of ensuring the integrity of all ecosystems, including oceans, when taking action to tackle climate change.[90]

40. Also of relevance in limiting ocean-based greenhouse gas emissions is annex VI to the International Convention for the Prevention of Pollution from Ships, 1973, on the prevention of air pollution from ships and the related energy efficiency measures adopted by the International Maritime Organization (IMO). This comprehensive mandatory regime includes both technical and operational measures designed to put in place best practices for fuel efficiency, as described in paragraph 72 below. A system for collecting data on ships' fuel oil consumption will be mandatory and apply globally at the beginning of 2019 and a comprehensive strategy on the reduction of greenhouse gas emissions from ships will be developed, with an initial strategy foreseen for adoption in 2018.[91]

41. Measures to regulate marine geoengineering (see also paras. 76-78 below) in the context of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Convention), and the Protocol of 1996 thereto (London Protocol) are also relevant, given the potential impact of some

[83] In article 1 of the United Nations Convention on the Law of the Sea, "pollution of the marine environment" is defined as the "introduction by man, directly or indirectly, of substances or energy into the marine environment which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities".

[84] United Nations Convention on the Law of the Sea, articles 192, 194 and 212.

[85] Ibid., articles 61 and 117.

[86] Convention on Biological Diversity, article 8.

[87] Other conventions addressing the conservation and sustainable use of specific ecosystems and/or species are also relevant in this context, such as the Convention on Wetlands of International Importance especially as Waterfowl Habitat and the Convention on the Conservation of Migratory Species of Wild Animals.

[88] United Nations Framework Convention on Climate Change, article 2. See also article 2 of the Paris Agreement.

[89] United Nations Framework Convention on Climate Change, article 4 (1) (d).

[90] Paris Agreement, fourteenth preambular paragraph.

[91] IMO contribution.

geoengineering methods aimed at mitigating the effects of climate change on the marine environment.[92] Amendments to the London Protocol to regulate carbon dioxide sequestration in subseabed geological formations were adopted in 2006.[93]

42. At the regional level, the resilience of marine ecosystems in the face of climate change is promoted through various instruments that pertain to, among other things, the development of integrated coastal zone management as a means to prevent and/or reduce the effects of climate change[94] and the establishment of marine protected areas.[95]

43. Since 2006, the General Assembly has drawn attention in its annual resolutions on oceans and the law of the sea and on sustainable fisheries to the need to address the impacts of climate change and ocean acidification on marine ecosystems, including the impacts on the sustainability of fish stocks and the habitats that support them.[96] The work of its subsidiary bodies on ocean-related issues is also of relevance in this context. For example, the First Global Integrated Marine Assessment, the outcome of the first cycle of the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects, pertains to the impacts of climate change and related changes in the atmosphere, based on the work of IPCC (see para. 64 below). The impacts of climate change and ocean acidification are also of relevance to the work of the Preparatory Committee established by General Assembly resolution 69/292: Development of an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction.

44. In its resolutions on sustainable fisheries, the General Assembly has expressed concern over the current and projected adverse effects of climate change on food security and the sustainability of fisheries and urged the intensification of efforts to assess and address those impacts. In addition, at the resumed Review Conference on the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, in 2016, States emphasized that there was a need for close collaboration among all relevant stakeholders in conducting research on the risks and impacts of climate change on fish stocks. They also committed themselves to exploring ways to incorporate the consideration of the adverse impacts of climate change and ocean

[92] IMO, document LC 31/15, annex 5, resolution LP.3(4); and document LC 35/15, annex 4, resolution LP.4(8).

[93] IMO contribution.

[94] See, for example, the Protocol on Integrated Coastal Zone Management in the Mediterranean to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean.

[95] See, for example, the Protocol concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region; the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean; the Protocol concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region; the Commission for the Conservation of Antarctic Marine Living Resources conservation measure 91-04; and the Convention for the Protection of the Marine Environment of the North-East Atlantic recommendation 2003/3.

[96] See resolutions 71/257 and 71/123.

acidification and related uncertainties regarding fisheries into decision-making processes for the adoption of conservation and management measures, in line with the precautionary approach.[97]

45. The synergies between sustainable development, oceans, climate change and ocean acidification are also prominent in a number of other policy instruments, including the outcome document of the United Nations Conference on Sustainable Development, entitled "The future we want",[98] the 2030 Agenda for Sustainable Development[99] and the SIDS Accelerated Modalities of Action (SAMOA) Pathway (Samoa Pathway)[100] at the global level and the Mediterranean Strategy for Sustainable Development 2016-2025 at the regional level.[101] These policy documents contain recognition of the need to conserve and sustainably use oceans, seas and marine resources and of the fact that sea level rise, ocean acidification and other adverse impacts of climate change pose a significant risk to efforts to achieve sustainable development, in particular for small island developing States and least developed countries. The United Nations Conference to Support the Implementation of Sustainable Development Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development, to be held in New York from 5 to 9 June 2017, will provide an important opportunity to address ways to support the implementation of Goal 14.

46. In relation to disaster management, the Sendai Framework for Disaster Risk Reduction 2015-2030 provides a global framework to guide decision makers towards a more disaster-resilient future. In the Sendai Declaration, a call is made for the mainstreaming of disaster risk assessment, mapping and management into rural development planning and management of, among other things, coastal floodplain areas, including by preserving ecosystem functions that help to reduce risks.[102]

47. Many of the phenomena resulting from climate change, including the increasing frequency of extreme weather events and natural disasters, rising sea levels and floods, directly and indirectly threaten the full and effective enjoyment of a range of human rights, including those to life, water and sanitation, food, health, housing, self-determination, culture and development.[103]

48. Given that mitigation and adaptation measures can also have human rights impacts, all action relating to climate change must respect, protect, promote and fulfil human rights standards and should be taken following a human rights-based

[97] See A/CONF.210/2016/5, annex, sect. A.4 (b).

[98] Resolution 66/288, annex.

[99] Resolution 70/1; see also Department of Economic and Social Affairs contribution.

[100] Resolution 69/15, paras. 31 and 44; see also Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States contribution.

[101] UNEP/MAP, Mediterranean Strategy for Sustainable Development 2016-2025, objective 4.

[102] Resolution 69/283, annex I.

[103] While no reference is made in the universal human rights treaties to a specific right to a safe and healthy environment, the treaty bodies all recognize the intrinsic link between the environment and the realization of a range of human rights, i.e. the Declaration of the United Nations Conference on the Human Environment, principle 1; the Convention on the Rights of the Child, article 24 (2) (c); and the Indigenous and Tribal Peoples Convention, 1989 (No. 169), of the International Labour Organization. For additional detail, see A/HRC/10/61.

approach.[104] Human rights principles articulated in the Declaration on the Right to Development call for such climate action to be both individual and collective and for it to benefit the most vulnerable.[105]

49. In view of the impacts on coastal communities generated by the effects of climate change on the ocean (see paras. 20 and 27 above), applicable human rights instruments are also relevant. To reduce the risk of displacement of communities vulnerable to the effects of extreme weather disasters and climate change, the Office of the United Nations High Commissioner for Refugees has developed guidance for States regarding how to plan for relocation.[106] The vast majority of affected people, thus far, are displaced within their countries. States therefore have the primary duty and responsibility to protect and assist those internally displaced persons, in accordance with their human rights obligations. The Guiding Principles on Internal Displacement also provide a basis for legislation or policies on internal displacement, including in disaster contexts.[107] When displaced persons cross international borders, they are not normally considered refugees under the terms of the 1951 Convention relating to the Status of Refugees.[108] The State-led Nansen Initiative, which ran from 2012 to 2015, was established to fill that gap and resulted in the endorsement of the Agenda for the Protection of Cross-Border Displaced Persons in the Context of Disasters and Climate Change,[109] followed by the Platform on Disaster Displacement.[110]

Challenges and opportunities in the implementation of existing agreements

50. Integrated and coherent approaches to tackle the effects of climate change and ocean acidification on the oceans can be further developed only through enhanced cooperation and coordination at all levels in the implementation of legal, policy and management frameworks for both climate change and oceans.

51. Existing instruments provide, among other things, a framework to mitigate greenhouse gas emissions, adapt to impacts and increase marine ecosystem resilience, all of which are critical in responding to the effects of climate change on oceans. The effective implementation of these instruments can therefore be mutually reinforcing. For example, the effective implementation of the United Nations Convention on the Law of the Sea and related instruments on the protection and preservation of the marine environment and the conservation and management of living marine resources contributes to enhancing the absorptive capacity of oceans as carbon sinks and to reaching mitigation targets under the Paris Agreement, while also ensuring that oceans are resilient to the impacts of climate change. Conversely, reaching the mitigation and adaptation objectives set out in the United Nations Framework Convention on Climate Change and the Paris Agreement is essential for

[104] See http://www.ohchr.org/EN/Issues/HRAndClimateChange/Pages/HRClimateChangeIndex.aspx.
[105] Resolution 41/128.
[106] See http://www.unhcr.org/protection/environment/562f798d9/planned-relocation-guidance-october-2015.html.
[107] E/CN.4/1998/53/Add.2. At the regional level, the African Union Convention for the Protection and Assistance of Internally Displaced Persons in Africa provides legal protection for those forced to flee their homes as a result of natural disasters and other specified reasons.
[108] Office of the United Nations High Commissioner for Refugees contribution.
[109] See https://www.nanseninitiative.org/.
[110] See http://disasterdisplacement.org/.

the protection of food security and livelihoods, for the effectiveness of conservation and management measures with regard to living marine resources, for efforts to prevent, reduce and control pollution of the marine environment and for ensuring that oceans continue to perform their role in climate regulation.

52. It is not yet clear what role oceans will have in the implementation of the Paris Agreement. Current climate models and scenarios assume that oceans will remain a carbon sink until 2100, yet they may become a source of greenhouse gases in the future, releasing previously emitted carbon dioxide that they have stored (see paras. 6-7 above).[111] Parties to the United Nations Framework Convention on Climate Change have identified key issues relating to oceans in the context of mitigation, adaptation and the pursuit of climate-resilient sustainable development, including as part of their national adaptation and mitigation targets under their intended nationally determined contributions. They include a need to enhance observation, research and capacity-building, develop supportive institutional, legal and policy frameworks and plan actions addressing emissions reductions, livelihood diversification, conservation and risk management.[112]

53. The implementation of the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts[113] will also be relevant in the context of the impact of climate change on oceans, given that it pertains to related socioeconomic effects, namely loss and damage as a result of sea level rise and ocean acidification, in addition to other incremental impacts such as salinization, land and forest degradation, loss of biodiversity, increasing temperatures and glacial retreat.[114]

54. Neither the United Nations Convention on the Law of the Sea nor customary international law addresses the impact of a total or partial loss of land territory that may result from sea level rise on maritime limits. Specified in the Convention are the maximum breadth of maritime zones and the sovereignty, sovereign rights and jurisdiction that coastal States can exercise therein. There is also an obligation thereunder for a coastal State to deposit with the Secretary-General charts or lists of geographical coordinates of its straight baselines, as well as outer limits and delimitation lines of its maritime zones. As a consequence of sea level rise, the land territory of coastal States may be dramatically diminished or, in extreme cases, disappear. Baselines that may have been fixed and deposited with the Secretary-General, and the outer limits of maritime zones or delimitation lines measured therefrom, may represent the configuration of the coastline before sea level rise. With the exception of article 7 (2), concerning unstable coastlines caused by deltas and other natural conditions, the Convention does not pertain to variations in coastal geography.

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[111] Secretariat of the United Nations Framework Convention on Climate Change contribution.

[112] Ibid.

[113] It was established to address loss and damage associated with the impacts of climate change, including extreme events and slow-onset events, in developing countries that are particularly vulnerable to the adverse effects of climate change. See decision 3/CP.19 of the Conference of the Parties to the United Nations Framework Convention on Climate Change.

[114] Secretariat of the United Nations Framework Convention on Climate Change contribution.

B. Science and data collection

55. A scientific understanding of oceans is fundamental for the effective management of human activities that affect the marine environment and to support policymaking.[115] Although scientific data and knowledge on oceans have increased in recent decades, including through programmes such as Horizon 2020, the European Union framework programme for research and innovation,[116] gaps remain, in particular with regard to consistent coverage of data and the infrastructure to collect and disseminate data and information.[117]

56. Broadly, there are gaps in knowledge of coastal and ocean processes.[118] Gaps persist in understanding sea temperature, sea level rise, salinity distribution, carbon dioxide absorption and nutrient distribution and cycling.[119] There are gaps in knowledge regarding the use of sea level data in models to determine changes in coastal processes and changes in shorelines.[120] To fully monitor the impacts of climate change, more needs to be done at water depths below 2,000 m and on a wider range of variables.[121]

57. Finer-resolution climate modelling would more accurately reflect the effects of climate change.[122] There has been a call for the development of indicators for monitoring change and drivers of change and an increased use of novel observation tools, in addition to mobile monitoring stations.[123] It has been noted that underwater cultural heritage sites can provide strong evidence of past climate change and serve as indicator sites for changing currents, erosion and changing environmental conditions.[124]

58. The development of a specific global framework for land/sea physical interaction assessment needs has been suggested, including by improving the capacity of persons who collect and analyse existing and new data at the local, regional and basin-wide levels.[125] In addition, support is needed for continuing in-situ measurements and for

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[115] United Nations, "World Ocean Assessment I", chap. 30, pp. 1 and 9; see also A/66/70/Add.1, paras. 275-276.

[116] One major contribution made through Horizon 2020 to climate-related ocean observations is through the AtlantOS project, for which the European Union has invested more than €20 million. Regarding the impact of climate change on fisheries and aquaculture, other projects funded under Horizon 2020 (CERES and ClimeFish) address the threats and opportunities that the aquatic primary production sector is facing and develop adaptation strategies. Climate-related marine research has also been central under the seventh framework programme for research and technological development, with several projects such as MedSeA, VECTORS and MEECE addressing issues including the effects of climate change on marine ecosystems and human activities in the Mediterranean Sea, the Atlantic Ocean, the Baltic Sea and the Black Sea. See European Union contribution.

[117] See UNEP(DEPI)/MED WG.421/Inf.19.

[118] Secretariat of the United Nations Framework Convention on Climate Change contribution.

[119] United Nations, "World Ocean Assessment I", chap. 9.

[120] Ibid., chap. 26, sect. 6.

[121] Secretariat of the United Nations Framework Convention on Climate Change contribution.

[122] Indonesia and secretariat of the United Nations Framework Convention on Climate Change contributions; see also FCCC/CP/2015/7, para. 296.

[123] Helsinki Commission contribution.

[124] UNESCO contribution.

[125] United Nations, "World Ocean Assessment I", chap. 26, sect. 6.

the re-establishment of discontinued data collection programmes, as well as for initiating new studies, given that forecasting ocean processes is a required capability for addressing climate change and sea level rise.[126] There is an observed shortage of the data and local expertise required to assess risks relating to sea level rise, in particular for small island developing States. Traditional knowledge could be an additional resource in support of adaptation.[127]

59. Understanding and forecasting the impacts of climate change on oceans, as well as detection of changes and validation models, will require collaborative efforts to gather and analyse observational data over a lengthy period.[128] To this end, collaborative projects and programmes are being conducted for science and data collection with regard to climate change and oceans.[129] Nevertheless, attaining and sustaining global observation coverage has been identified as the most significant challenge facing oceanic climate observation systems.[130]

60. With regard to the sharing of data, States have continued to work in collaboration with international organizations to expand the pool of data and knowledge.[131] A need to enhance the sharing of data has been recognized, and many systems are already in place: of particular note are the Ocean Biogeographic Information System[132] and the world's largest collection of publically available oceanographic information managed by the National Centers for Environmental Information.[133] The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) is also engaged in coordinated activities relating to climate change (see para. 78 below).[134]

61. Nevertheless, the systematic sharing of data by Governments, universities and other institutions is not universal and calls have been made to enhance this form of cooperation,[135] including by increasing capacity to gain access to the information currently available.[136] General gaps have been observed in techniques for combining

[126] Ibid.

[127] Ibid., chap. 4, sect. 2; see also Indonesia contribution.

[128] United Nations, "World Ocean Assessment I", chap. 30, p. 9; see also Helsinki Commission contribution.

[129] In particular, the Global Ocean Observing System provides observed information on oceans, and the World Climate Research Programme conducts a wide range of related scientific research activities. See IOC contribution.

[130] Secretariat of the United Nations Framework Convention on Climate Change contribution.

[131] Indonesia, Namibia, New Zealand, Republic of Korea, United States, European Union, International Atomic Energy Agency, IHO, International Seabed Authority, North Atlantic Salmon Conservation Organization, SPC and UN-Habitat contributions.

[132] This is an integration of more than 1,900 databases, which is particularly useful for tracking climate change impacts on marine biodiversity (IOC contribution).

[133] United States contribution.

[134] The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) has established relevant working groups, such as working group 41 on marine geoengineering and working group 38 on the atmospheric input of chemicals in oceans, and also works through a correspondence group on the issue of the massive arrival of pelagic sargassum. See GESAMP, *Report of the Forty-second Session of GESAMP*, reports and studies No. 92 (Paris, IOC, 2015). See also WMO contribution.

[135] See A/66/70/Add.1, paras. 363-364; UNEP(DEPI)/MED WG.421/Inf.19; Helsinki Commission contribution.

[136] See A/69/71/Add.1, para. 120.

information on the various aspects of oceans to give an overall picture.[137] More transdisciplinary research and sharing of knowledge among appropriate institutions is needed in order to better understand the impacts of climate-related geoengineering on biodiversity and ecosystem functions and services, socioeconomic, cultural and ethical issues and regulatory options.[138]

62. The importance of a robust institutional mechanism for the collection of relevant scientific data that may contribute to the specific climate-resilient sustainable development of oceans and seas has been noted.[139] A call has also been made for the establishment of a specific United Nations body to coordinate and strengthen data collection, technology application and knowledge management.[140]

63. The General Assembly has encouraged collaboration in scientific activity to better understand the effects of climate change and ocean acidification on the marine environment and marine biodiversity, as well as to develop ways and means of adaptation.[141]

64. The Regular Process will have an essential role in strengthening the science-policy interface.[142] The General Assembly[143] decided that the second cycle of the Regular Process would produce a second world ocean assessment or assessments and support other ocean-related intergovernmental processes, including through the preparation of technical abstracts specifically tailored to the requests and needs of such processes. One of the abstracts is focused on oceans and climate change, supporting the United Nations Framework Convention on Climate Change process and the eighteenth meeting of the Informal Consultative Process.[144] IPCC is preparing a special report on climate change and oceans and the cryosphere, which will become available in 2019.[145]

C. Ocean-based adaptation and mitigation action and climate-resilient sustainable development

65. While the scientific knowledge base continues to increase, such information and related assessments of associated socioeconomic impacts and vulnerabilities have only recently begun to be used for the identification of ocean-based adaptation and mitigation options and climate-resilient sustainable development action. Similarly, even though marine species are adapting to climate change through

[137] United Nations, "World Ocean Assessment I", chap. 54, sect. 2.2.

[138] Decision XIII/14 of the Conference of the Parties to the Convention on Biological Diversity, on climate-related geoengineering.

[139] Bangladesh contribution.

[140] Indonesia contribution.

[141] Resolution 71/257, paras. 185 and 191.

[142] United Nations, "World Ocean Assessment I", chap. 26, sect. 6.

[143] Resolution 71/257, para. 296.

[144] The General Assembly has also underlined the importance of ensuring that assessments, such as those included in the *Global Sustainable Development Report* and those prepared by IPCC, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services and the Regular Process, support one another and avoid unnecessary duplication (see resolution 71/257, para. 293).

[145] See IPCC decision IPCC/XLIII-6. See also secretariat of the United Nations Framework Convention on Climate Change and IOC contributions.

shifting distributions and timing of biological events (see para. 11 above), ocean-based adaptation[146] action and the evaluation of outcomes remain at an initial stage for social systems.[147] At the regional level, action has been taken to increase the resilience of ecological and socioeconomic systems to the impacts of climate change.[148] For example, the Pacific Community is supporting the implementation of integrated coastal management projects that take holistic approaches to addressing local development and resilience in a changing climate.[149] In their contributions, a few States also reported on the incorporation of climate change considerations into coastal management.[150] Going forward, holistic, coordinated and integrated approaches at all levels require enhancement through, for example, integrated coastal zone management and/or in the context of marine spatial planning.

66. Strategies to enhance the adaptation and resilience of both ecological and socioeconomic systems are necessary to tackle the current and future unavoidable effects of climate change. Given that climate change poses a severe threat to sustainable development, including through increases in coastal vulnerability,[151] development trajectories need to combine adaptation and mitigation to realize the goals of sustainable development, while maintaining climate resilience.[152] This is particularly challenging for small island developing States, owing to their vulnerabilities linked to their relative remoteness and territorial size and relatively narrow resource base.[153]

67. Regional risk management platforms could be established to foster collaborative action to coordinate the management of weather-related risks and build risk prevention and management capabilities.[154]

68. Ecosystem-based adaptation is emerging as a viable option for Governments to increase resilience to the impacts of climate change. It promotes ecosystem health, allowing local populations to benefit from the environmental services provided, such as the provision of clean water, improved habitat for fish supplies and, more notably, protection from extreme weather and sea level events. Healthy ecosystems

[146] Adaptation refers to the adjustments in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It also refers to changes in processes, practices and structures to moderate potential damage or to benefit from opportunities associated with climate change.

[147] Nippon Foundation, University of British Columbia, Nereus Program, working paper, 2016 (forthcoming).

[148] Azerbaijan and UNEP/MAP contributions.

[149] SPC contribution.

[150] Azerbaijan, Indonesia and Unites States contributions; the secretariat of the United Nations Framework Convention on Climate Change in its contribution noted that 54 countries had outlined action for coastal protection in their intended nationally determined contributions.

[151] F. Denton and others, "Climate-resilient pathways: adaptation, mitigation, and sustainable development", in IPCC, *Climate Change 2014: Impacts, Adaptation, and Vulnerability*.

[152] Climate resilience refers to the ability of social and ecological systems to anticipate, reduce, accommodate or recover from the effects of climate change in a timely and efficient manner.

[153] Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States contribution.

[154] UNEP contribution.

can also serve as carbon sinks and thus provide the added benefit of mitigating local greenhouse gases.[155] Marine protected areas are an important tool in this context.[156]

69. Enhanced activities are needed to assist stakeholders at all levels to develop tools to plan for the impacts of climate change. It will be important to raise awareness of how natural solutions can support adaptation. Local information also requires enhancement to foster adaptation planning at the community and national levels.[157] The development of alternative incomes and livelihoods needs to be considered along with the introduction of more advanced forms of technology for the fish and marine industries.[158]

70. Parties to the United Nations Framework Convention on Climate Change have addressed ocean-related action in the adaptation components of their intended nationally determined contributions, in particular in relation to fisheries management.[159] Several United Nations system entities are supporting States in the development and implementation of national adaptation plans and access to financial resources for the implementation of field projects addressing the vulnerabilities identified.[160] The Food and Agriculture Organization of the United Nations (FAO), for example, is developing guidelines on the use of spatial technology, such as satellite remote sensing for disaster assessment and emergency preparedness for aquaculture.[161] Regional fisheries management organizations are considering the use of fishery forecasts and enhanced understandings on linkages between climate variables and fish stock conditions in the development of conservation measures.[162]

71. The response of the International Hydrographic Organization to disasters is aimed at ensuring the immediate assessment of damage and its effect on the safety of navigation, informing mariners and other interested parties of relevant damage and any dangers, in particular with regard to navigational hazards, re-establishing

[155] Indonesia, UN-Habitat and UNEP contributions.

[156] The secretariat of the Convention on Biological Diversity reported that the parties to the Convention emphasized the importance of establishing marine protected areas, coastal resource management and marine spatial planning in building the resilience of marine and costal ecosystems and encouraged the use of ecosystem-based approaches to climate change adaptation, mitigation and disaster risk reduction. UNEP is providing support to countries in applying ecosystem-based adaptation and pilot activities have been implemented in several small island developing States (secretariat of the Convention on Biological Diversity contribution). UNEP is also enhancing current knowledge on future bleaching to enhance reef management and on carbon storage and sequestration and ecosystem services provided by blue forest ecosystems, namely mangroves, seagrass and salt marshes, with the aim of contributing to ocean-based adaptation and mitigation (UNEP contribution). IOC is working with States to enhance knowledge of their adaptive capacities. Entry points are integrated coastal area management, through coastal adaptation handbooks, ocean governance and marine assessments such as the Transboundary Waters Assessment Programme (IOC contribution). See also Helsinki Commission contribution.

[157] FAO contribution.

[158] For example, in storage, packaging and other aspects of the production chain (Indonesia contribution).

[159] Secretariat of the United Nations Framework Convention on Climate Change contribution.

[160] See relevant contributions.

[161] FAO contribution.

[162] North Atlantic Salmon Conservation Organization, North-East Atlantic Fisheries Commission, North Pacific Anadromous Fish Commission and SPC contributions.

the basic key maritime transportation routes and ensuring that charts of and other hydrographic information pertaining to affected areas are updated as soon as possible.[163]

72. In terms of mitigation, given that the main drivers of climate change include emissions emanating from carbon-based fuels, ocean-based mitigation action is focused on the reduction of such emissions from ships and reducing dependency on carbon-based energy by promoting marine renewable sources of energy. With the adoption of the Energy Efficiency Design Index and the Ship Energy Efficiency Management Plan in 2011, IMO has moved decisively to reduce carbon dioxide emissions by promoting the use of energy-efficient equipment and engines. It has also actively addressed air pollution from vessels (see para. 40 above), which is particularly relevant to global mitigation efforts, given that ships emit more particulate matter and black carbon per unit of fuel consumed than other combustion sources owing to the quality of the fuel used.[164]

73. The energy sector, which accounts for some two thirds of global greenhouse gas emissions,[165] has an essential role in any mitigation effort. Annual global investment in renewables-based power generation technologies already exceeds investment in other types of power plants thanks to widespread policy support and the falling costs.[166] These technologies will be an increasingly essential element in decarbonizing the energy sector.[167] Marine renewable energy[168] in particular offers the potential to meet the increasing global energy demand while reducing long-term carbon emissions.[169]

74. Many of the technologies are at a nascent or developing stage. Offshore wind energy appears to have the greatest immediate potential for energy production, grid integration and climate change mitigation.[170] Nevertheless, the potential for other sources to provide multiple mitigation effects cannot be overlooked. For example, algae grown for biofuels can also provide a sink for carbon dioxide.[171]

75. Mitigation actions also include those aimed at ensuring that oceanic systems maintain their capacity as carbon sinks. Such actions would include the implementation of ecosystem-based management, sustainable use, conservation and restoration, including enhancing carbon sequestration by managing sinks and reservoirs and carbon stocks, and reducing and minimizing conversion and greenhouse gas emissions.[172]

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[163] IHO contribution.

[164] D. A. Lack and J. J. Corbett, "Black carbon from ships: a review of the effects of ship speed, fuel quality and exhaust gas scrubbing", in *Atmospheric Chemistry and Physics*, vol. 12, No. 9 (May 2012).

[165] OECD and International Energy Agency, "Energy and climate change", World Energy Outlook Special Report (Paris, International Energy Agency, 2015), p. 20.

[166] Ibid., p. 109.

[167] Ibid.

[168] For example, through offshore wind power, ocean wave energy, tidal power, ocean current energy, ocean thermal conversion and osmotic power and marine biomass energy.

[169] United Nations, "World Ocean Assessment I", chap. 22.

[170] Ibid.

[171] Ibid.

[172] See FCCC/SBSTA/2014/INF.1.

76. The use of geoengineering techniques to mitigate climate change and its effects, including solar radiation management, ocean fertilization and carbon dioxide removal, has been approached carefully by the international community (see para. 41 above).[173] Proposals to directly or indirectly sequester carbon dioxide into oceans include the use of ocean fertilization techniques by nutrient addition, the direct storage of biomass in the deep ocean, the addition of alkalinity for the build-up of dissolved inorganic carbon and the direct injection of carbon dioxide into the deep ocean.[174] While acknowledging that the knowledge of the implementation of these forms of technology and associated risks is insufficient, IPCC has noted with high confidence that comparative assessments suggest that the main ocean-related geoengineering approaches are extremely costly and have large environmental footprints.[175]

77. The absence of science-based, global, transparent and effective control and regulatory mechanisms for geoengineering and the need for a precautionary approach in relation to ocean fertilization have been reaffirmed by the parties to the Convention on Biological Diversity in several decisions, including a decision that no climate-related geoengineering activities that may affect biodiversity may take place until there is an adequate scientific basis on which to justify such activities and appropriate consideration has been given to associated environmental, social, economic and cultural impacts, with the exception of small-scale scientific research studies conducted in controlled settings.[176]

78. A new GESAMP working group[177] was tasked with assessing a wide range of marine geoengineering approaches for their potential environmental and socioeconomic impacts on the marine environment and their potential scientific practicality and efficacy for climate mitigation purposes. The final peer-reviewed report is intended to assist the parties to the London Convention and the London Protocol to determine which marine geoengineering activities may be listed in annex 4 to the Protocol and consequently regulated.[178]

D. Capacity-building, partnerships and financing

79. Capacity-building is an essential component of the global response to climate change. Associated with the need to support capacity-building in developing countries has been the idea that developed countries, being those historically responsible for greenhouse gas emission levels, have a duty to help to finance the costs of climate change responses in the most vulnerable countries.[179]

80. The two issues are inextricably linked, given that the building of institutional and human capacity, without adequate climate finance, would not in and of itself assist developing States, which are bearing disproportionate impacts, in

[173] IPCC, *Climate Change 2014: Impacts, Adaptation, and Vulnerability*, p. 454.
[174] Ibid.
[175] Ibid.
[176] Secretariat of the Convention on Biological Diversity contribution.
[177] The GESAMP working group is under the lead of IMO, with support from IOC, and co-chaired by independent experts.
[178] WMO contribution.
[179] United Nations Framework Convention on Climate Change, article 4 (4).

implementing solutions to the impacts of climate change. In addition, without proper capacity, developing States find it difficult to even gain access to climate finance, or to use it effectively to implement solutions. Indeed, articles 9 and 11 of the Paris Agreement, on climate finance and capacity-building, respectively, pertain to the link between the concepts.

81. Various partnerships and organizations are focused on building the capacity of States to pursue climate-resilient development. These include the African Package for Climate-Resilient Ocean Economies,[180] the Global Strategic Action Initiative on Oceans and Climate,[181] the Ocean Acidification International Coordination Centre and Global Ocean Acidification Observing Network,[182] the FAO strategy for fisheries, aquaculture and climate change for the period 2017-2020[183] and the Global Coral Reef Partnership with regional seas programmes.

82. Capacity-building activities have also been focused on disaster risk reduction in the face of climate change. For example, FAO completed fisheries and aquaculture emergency response guidance[184] and the World Meteorological Organization launched a dedicated programme to help small, vulnerable islands to use weather, marine and climate services, which will assist them in coping with extreme weather.[185] The International Hydrographic Organization capacity-building programme includes workshops and training courses on establishing maritime spatial data infrastructure, tidal observations and tsunami inundation mapping;[186] the Intergovernmental Oceanographic Commission Small Island Developing States Action Plan and Implementation Strategy builds actions among those States relating to tsunami early warning systems[187] and International Atomic Energy Agency projects support capacity-building to use nuclear techniques to monitor and mitigate the effects of climate change on oceans.[188] The Sustainable Ocean Initiative, under the Convention on Biological Diversity, is identifying opportunities to address capacity needs to achieve the Aichi Biodiversity Targets, including the effects of climate change on marine biodiversity.[189]

83. The Pacific Community is involved with partners in capacity development and training activities, including by developing and strengthening the skills of staff at the national and subnational levels in monitoring, control, surveillance and

[180] The African Package for Climate-Resilient Ocean Economies aims to mobilize $3.5 billion in the period 2017-2020 (UNEP contribution).

[181] The Global Strategic Action Initiative on Oceans and Climate developed a road map for the period 2016-2021 that addresses six interrelated ocean and climate issue areas. See https://globaloceanforumdotcom.files.wordpress.com/2013/03/strategic-action-roadmap-on-oceans-and-climate-november-2016.pdf.

[182] The Global Ocean Acidification Observing Network supports the building of scientific capacity of developing countries. See http://goa-on.org/.

[183] FAO, the World Bank and the African Development Bank recently announced the African Package. See FAO contribution.

[184] FAO contribution.

[185] WMO contribution.

[186] IHO contribution.

[187] The Action Plan and Implementation Strategy were adopted by the IOC member States in 2016 in response to the Samoa Pathway (IOC contribution).

[188] International Atomic Energy Agency contribution.

[189] Secretariat of the Convention on Biological Diversity contribution.

enforcement in support of the sustainable management of coastal marine resources.[190]

84. States and intergovernmental organizations are also engaging in awareness-raising activities on the impacts of climate change on oceans, including through the organization of conferences[191] and the release of policy briefs and knowledge products intended for both the general public and policymakers and providing an overview of climate change implications and vulnerabilities, as well as potential adaptation and mitigation options.[192]

85. In terms of financing, donor States are providing development assistance to strengthen resilience. For example, New Zealand and the United States of America[193] are supporting Pacific small island developing States, including through financial assistance and capacity-building, to manage the impacts of climate change and ocean acidification in the region.[194]

86. On the climate finance side, the international community has established multilateral funds to serve as vehicles for the provision of financial resources to assist developing countries in the implementation of their commitments under the United Nations Framework Convention on Climate Change.[195] The Green Climate Fund Readiness and Preparatory Support Programme was established to strengthen and build enabling environments to allow developing countries to gain access to Fund resources. Beyond readiness, the Fund can consider further support for capacity-building under its current thematic windows where such activities are identified by countries as their priority areas.[196] The Special Climate Change Fund supports adaptation activities in various areas, including the protection of fragile ecosystems and the promotion of integrated coastal management.[197]

87. Other important funds include the Climate Investment Funds, which host a pilot programme for climate resilience and are administered by the World Bank and use the multilateral development banks for programme and project implementation.

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[190] SPC contribution.

[191] The following conferences are among those that specifically addressed issues relating to the effects of climate change on oceans: the World Ocean Conference, held in Bali, Indonesia, on 14 May 2009, and the Our Ocean, One Future conferences, held in Washington, D.C., on 16 and 17 June 2014 and 15 and 16 September 2016 and in Valparaiso, Chile, in October 2015.

[192] Azerbaijan, Indonesia, Namibia, New Zealand, United States, secretariat of the Convention on Biological Diversity, FAO and UNEP contributions.

[193] The United States reported pledging some $40 million to capacity-building programmes to foster the climate-resilient sustainable development of oceans and coastal communities in the Pacific. See United States contribution.

[194] New Zealand and United States contributions.

[195] These include the two operating entities of the financial mechanism of the United Nations Framework Convention on Climate Change — the Global Environment Facility and, more recently, the Green Climate Fund — as well as three special purpose funds: the Adaptation Fund, the Special Climate Change Fund and the Least Developed Countries Fund. See UNEP(DEPI)/MED IG.22/Inf.11.

[196] See FCCC/CP/2016/7/Rev.1.

[197] See GEF, "Programming to implement the guidance for the Special Climate Change Fund adopted by the Conference of the Parties to the United Nations Framework Convention on Climate Change at its ninth session", document GEF/C.24/12. Available from http://www.thegef.org/sites/default/files/council-meeting-documents/C.24.12_5.pdf.

Another growing funding mechanism is the issuance of green bonds, which grew from $11 billion in 2013 to $36.6 billion in 2014.[198]

88. Greater emphasis should be placed on galvanizing multi-stakeholder partnerships to tackle the impacts of climate change on oceans.[199] Private partnerships, such as the Global Resilience Partnership, and the private sector are also playing an important role.[200]

89. Given that sustained funding to support ocean-related activities remains a challenge, the availability of climate finance and capacity-building mechanisms could be further explored to support coordinated, integrated and coherent mechanisms and frameworks aimed at promoting the sustainable development of oceans and seas and ocean-based adaptation and mitigation objectives.

E. Enhancing inter-agency coordination

90. Global and regional organizations have been undertaking activities to enhance cooperation and coordination in relation to the effects of climate change and acidification on oceans.[201]

91. As the inter-agency coordination mechanism on ocean and coastal issues within the United Nations system, UN-Oceans has developed an inventory of mandates and activities by its members[202] with the objective of sharing information on current and planned activities by participating organizations and identifying possible areas for collaboration and synergy. The inventory contains a list of activities by its members relating to, among other issues, climate change. Under the work programme for 2016-2017, UN-Oceans, supported by the inventory, will continue to identify possible areas for collaboration and synergy.[203] Furthermore, the members of UN-Oceans have already been engaged in joint activities highlighting the important role of oceans in regulating the climate and the impacts of climate change and ocean acidification on the marine environment.[204]

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[198] Ibid.

[199] For example, during the climate change conference held in Marrakech, Morocco, from 7 to 18 November 2016, an "ocean day" was convened as part of the Marrakech Partnership for Global Climate Action. The day brought together representatives of Governments, civil society, the private sector, the scientific community and dedicated international organizations to discuss successful multi-stakeholder initiatives on oceans and climate change, exchange learning experiences and best practices and set priorities for future collaboration and coordination.

[200] The Global Resilience Partnership aims to help millions of vulnerable people in the Sahel, the Horn of Africa and South and South-East Asia to better adapt to shocks and chronic stresses and invest in a more resilient future. Currently, it is working on novel solutions to flooding, including in coastal and riverine communities in South-East Asia. See http://www.globalresiliencepartnership.org/aboutus/.

[201] Secretariat of the Convention on Biological Diversity, Commission for the Conservation of Antarctic Marine Living Resources, FAO, IOC, North-East Atlantic Fisheries Commission, UNEP, secretariat of the United Nations Framework Convention on Climate Change and WMO contributions.

[202] See http://www.unoceans.org/inventory/en.

[203] See http://www.unoceans.org/fileadmin/user_upload/unoceans/docs/UN-Oceans_statement_to_ICP17_biennial_Work_Programme_2016_2017.pdf.

[204] Ibid.

V. Conclusions

92. The most notable effects of climate change and related changes in the atmosphere on the oceans are ocean warming, ocean acidification and consequent impacts, such as changes in ecosystems and biodiversity loss, sea level rise, extreme weather events and the loss of polar ice. In addition to other anthropogenic impacts, such as land-based pollution, unsustainable fishing practices and coastal development, there are serious cumulative effects, which are diverse, widespread and profound, not only affecting the ecology of the oceans, but also producing significant socioeconomic consequences for all States. These include loss of life, displacement of communities, loss of territory, destruction of property, decline of and regional shifts in fish stocks, coral bleaching and other ecosystem degradation. Accordingly, food security, livelihoods and sustainable development in developing States, especially in least developed countries and small island developing States, are increasingly affected and their vulnerabilities accentuated.

93. These impacts are progressive and expected to worsen, even under low-emission scenarios. There is an urgent need for additional integrated research and assessments to better understand their nature, scale, interactions and future trends. Such information would support the planning and implementation of successful action to tackle these global challenges in regional, national and local contexts. Urgently required action includes strengthening strategies to enhance the adaptation and resilience of both ecosystems and societies in order to address the current and future unavoidable effects of climate change, as well as substantial and sustained reductions of greenhouse gas emissions, including by assessing the extent to which oceans can continue to act as carbon sinks in the future.

94. To this end, concerted efforts are needed to promote the development of integrated, cross-sectoral and coherent approaches to address the effects of climate change and acidification on oceans. This can be achieved only through enhanced cooperation and coordination at all levels and effective partnerships among all stakeholders.

95. In particular, ways to enhance coordination in the implementation of relevant and mutually reinforcing legal and policy instruments require further consideration. Principally, the effective implementation of the United Nations Convention on the Law of the Sea and related instruments will contribute to building resilience and enhancing ocean-based mitigation, including the absorptive capacity of oceans as carbon sinks, which will in turn support efforts to reach adaptation and mitigation targets under the Paris Agreement. Conversely, reaching such targets is essential for the protection of ocean-based food security and livelihoods, for the effectiveness of conservation and management measures with regard to living marine resources and efforts to protect and preserve the marine environment. Accordingly, the role of the Paris Agreement in supporting the sustainable development of the oceans would also need to be considered by the parties to the Agreement within the framework of the United Nations Framework Convention on Climate Change. Enhancing these synergies would also support efforts to attain the Sustainable Development Goals and targets, including Goal 14.

96. Similarly, coordination among ocean and climate-related management objectives can be enhanced by mainstreaming adaptation and mitigation objectives

in the development of integrated and ecosystem-based coastal management. This will promote ecosystem health and climate resilience and allow local communities to benefit from ecosystem services, such as improved habitats for living marine resources and protection from extreme weather and sea level rise, as well as conserve coastal habitats as carbon sinks. Marine spatial planning and marine protected areas are important tools in achieving these objectives.

97. Having sustained funding to support ocean-related activities remains a challenge. Opportunities to use capacity-building and funding mechanisms, including climate finance, to promote both the sustainable development of oceans and seas and ocean-based adaptation and mitigation objectives should be further explored.